

WHAT IS CLAIMED IS:

1. A process for producing multimodal thermoplastic polymer foam comprising the following sequential steps:

5 (a) dispersing a blowing agent stabilizer and a blowing agent into a heat plasticized thermoplastic polymer resin at an initial pressure to form a foamable composition; and

10 (b) expanding said foamable polymer composition in a substantial absence of water and at a pressure less than said initial pressure to produce a multimodal thermoplastic foam.

15 2. The process of Claim 1, further comprising cooling said foamable composition between steps (a) and (b) and wherein step (a) further comprises shear to form the foamable composition.

3. The process of Claim 1, wherein the blowing agent stabilizer is present at a concentration of one to 50 weight-percent relative to polymer resin weight.

20 4. The process of Claim 1, wherein the blowing agent comprises a gas selected from a group consisting of carbon dioxide, hydrocarbons, and hydrofluorocarbons.

5. The process of Claim 4, wherein the hydrofluorocarbon is 1,1,1,2-tetrafluoroethane; the hydrocarbon is isobutane.

25 6. The process of Claim 1, wherein the blowing agent is carbon dioxide.

7. A thermoplastic polymer foam comprising a thermoplastic polymer resin having a multimodal cell size distribution containing large and small cells defined 30 therein and a blowing agent stabilizer predominantly located proximate to the large cells.

8. The thermoplastic polymer foam of Claim 7, wherein said foam contains one to 50 weight-percent of a blowing agent stabilizer relative to thermoplastic polymer resin weight.

5 9. The thermoplastic polymer foam of Claim 7, wherein said foam has a bimodal cell size distribution.

10 10. The thermoplastic polymer foam of Claim 7, wherein the blowing agent stabilizer is selected from a group consisting of non-plasticizing polyalkylene-oxide polymers and copolymers, non plasticizing polydimethylsiloxane and non-plasticizing functionalized polydimethylsiloxane.

15 11. The thermoplastic polymer foam of Claim 7, wherein the thermoplastic polymer resin is polystyrene and the blowing agent stabilizer is selected from a group consisting of polystyrene/polydimethylsiloxane block copolymers, polystyrene/polyoxyethylene block copolymers, polybutyl(meth)acrylate/polysiloxane/polybutyl(meth)acrylate block copolymers, polyethylene oxide grafted polystyrene/maleic anhydride random copolymers, and ethylene 20 glycol grafted polyurethane random copolymers.

25 12. The thermoplastic polymer foam of Claim 7, wherein the thermoplastic polymer resin is polypropylene and the blowing agent stabilizer is selected from a group consisting of polypropylene/polydimethylsiloxane block copolymers and polypropylene/polyoxyethylene block copolymers.

13. The thermoplastic polymer foam of Claim 7, further comprising a thermal insulating enhancing additive selected from a group consisting of carbon black (coated and non-coated) and graphite.

30 14. The thermoplastic polymer foam of Claim 7, wherein said foam has an R-value of at least 4.4 °F•ft<sup>2</sup>•h/Btu•in (30.5 K•m/W).

15. The thermoplastic polymer foam of Claim 7, wherein said foam has an R-value at least  $0.2 \text{ }^{\circ}\text{F}\cdot\text{ft}^2\cdot\text{h/Btu}\cdot\text{in}$  ( $1.4 \text{ K}\cdot\text{m/W}$ ) greater than an analogous foam prepared in the absence of blowing agent stabilizer.

5 16. The thermoplastic polymer foam of Claim 7, wherein said foam has a density of 0.5 to 50 pounds per cubic foot (8.0 to 801 kilograms per cubic meter).

10 17. The thermoplastic polymer foam of Claim 7, wherein said foam has a lower density than an analogous foam prepared in the absence of blowing agent stabilizer.

15 18. The thermoplastic polymer foam of Claim 7, wherein said thermoplastic polymer is selected from a group consisting of polystyrene, syndiotactic polystyrene, polypropylene, polyethylene, ethylene/propylene copolymers, ethylene/styrene copolymers, polymethylmethacrylate, polyethylene terephthalate, polycarbonate, polylactic acid, thermoplastic polyurethane, and polyethersulfone.

19. An article of manufacture comprising the thermoplastic polymer foam of Claim 7.

20 20. The article of manufacture of Claim 19, wherein said article is thermally insulating.